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Chapter

Housing and Rabbit Welfare in Breeding Does

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Abstract

Animal welfare is a rising concern in livestock production and to assess the welfare state of an animal, it is needed to consider health, behaviour and emotions. Housing conditions and management normally impair animal welfare at different levels, so developing housing systems and management practices that imply a high level of animal welfare by preserving productive results is a need. Rabbit cages have to be improved in terms of space, enrichment and materials used to promote better conditions, and several alternatives are under evaluation such as increasing available space, providing animals with elevated platforms and hiding spaces, making available gnawing materials or changing cage materials. Moving from individual to collective housing systems to enhance social interaction is also being tested. Most of these alternatives have provided some steps towards better housing and management conditions for rabbits, while some of them have demonstrated to create more problems and have been abandoned. There is still a long way to go on this research topic.

Keywords: behaviour, breeding does, environmental enrichment, group housing, housing, welfare

1. Introduction

Consumers, supermarkets, producers, politicians and other stakeholders are increasingly using the term animal welfare regarding livestock, as the public interest for animal welfare has been arising over the last four decades, especially in Europe. Rabbit rearing must adapt to these concerns, and re-thinking and re-organising husbandry systems seem needed.

In this chapter, we will explore animal welfare in rabbit production from a scientific perspective. The basics of animal welfare concept and evaluation will be described in depth, providing a scientific basis to assess such a complex topic. Rabbits have singular behavioural patterns, physical conditions and social relationships, not comparable to other livestock species, thus leading to specific needs in terms of housing and management.

Different housing systems will be explored throughout the chapter, considering the implication on animal welfare and productivity. Both present and new approaches will be considered.

2. Animal welfare

2.1 Definition and importance

Animal welfare is a term that has been created to express the ethical concerns of society about the animal's way of living, so it responds to social demands. However, it is a scientific concept [1], and there is a scientific method to identify, interpret and implement societal concerns about animal quality of life [2].

Due to this social and ethical origin, there might be as many definitions of animal welfare as people who are asked about it. In fact, it has been concluded [2] that it was impossible to give welfare a precise scientific definition. However, the most accepted definition of animal welfare is "the state of an animal as it attempts to cope with its environment, and the feelings associated to it" [3]. However, John Webster in [4] defends that "animal welfare is determined by its capacity to avoid suffering and sustain fitness", which modifies in some aspects Broom's definition, as it gathers how animals feel with the humans' responsibility. This fits with the "Five Freedoms" concept, which are the pillars of animal welfare nowadays and the base from which certifying protocols such as Welfare Quality® or AWIN® have aroused.

Five Freedoms are formulated as follows:

- Freedom from thirst, hunger and malnutrition
- Freedom from discomfort
- Freedom from pain, injuries and disease
- Freedom from fear and distress
- Freedom to express normal behaviour

These Five Freedoms refer to the ideal state, but they also might be interpreted as an absolute standard of good welfare, which prevents animal suffering [4].

2.2 Animal welfare in farmed animals, including rabbits

It has to be considered that there are several welfare problems that are inherent to animal production, mainly the lack of freedom of choice [4]. This lack of choice options is especially remarkable in caged systems, as behavioural repertoire is critically impaired mainly due to the lack of space or the isolation, so animal production has been deeply questioned in the last years.

In order to respond to this situation, the Council of the European Union (EU) has developed regulations for most of the farm species: Council Directive 98/58/EC for protection of animals kept for farming purposes, Council Directive 1999/74/EC (minimum standards for the protection of laying hens), Council Directive 2007/43/EC (minimum rules for the protection of chickens kept for meat production), Council Directive 2008/119/EC (minimum standards for the protection of calves) and Council Directive 2008/120/EC (minimum standards for the protection of pigs).

However, in the case of rabbits, the European Council has drafted 18 times the "Draft recommendation concerning domestic rabbit – *Oryctolagus cuniculus*" that was never definitively published. Thus, no regulation has been issued for the protection of farmed rabbits [5].

In the absence of EU directives, some member countries have drafted their own legislation or recommendations on the housing of farmed rabbits opting even for the abolition of cage housing systems.

If we want to speak about rabbit welfare, it is crucial to know some aspects about the natural behaviour of wild rabbits.

Rabbit domestication is very recent and there have not been many changes as compared to the wild rabbit, so the behaviour of domestic rabbit is still very similar to wild rabbit, and the biological needs are the same so, under commercial conditions, where specific behaviours or social relationships are impaired, there could arise a welfare problem [6]. Rabbits are social and gregarious animals, and, in wild conditions, they live in groups with more females than bucks (1–4 males and 1–9 females), except around giving birth, when they separate from the rest of the group: the dominant doe uses the common burrow and the rest of the females have to build their nest in different places [7] by mixing their own hair with grass or any other material they can find. The rabbits spend much time resting with conspecifics and in close contact, and fights are produced mainly by hierarchies [8]. However, young rabbits are easily tolerated if the group is not too big [9].

Olfaction is crucial for rabbits both in sexual and social behaviours, and hearing is also an important sense: big and mobile ears are useful for the detection of predators [9]. This characteristic of predated animal determines many behaviours of both wild and commercial rabbits. Ears also participate in body temperature regulation [10], and regarding to the vision, rabbits have a panoramic vision although not very precise [11].

On the other hand, rabbits have a unique feeding behaviour as compared to other species. Their feeding varies along the day and approximately 60% of the solid ingestion (except for caecotrophs) takes places during the dark period [12]. In addition, they also practice caecotrophy, ingesting soft faeces directly from the anus, mainly during the early morning. Finally, although rabbits are not rodents, one of their essential characteristics is the need for gnawing.

Rabbits in nature move throughout small hops (hopping), although if they are under alert, they can also walk gently. Playing behaviour is also common among kits, as well as scratching associated to the building of the hutch or exploration. Rabbits usually rest by lying down on the belly with the back legs stretched or shrink depending on if they are in alert or resting state, respectively. They can also lie laterally, which indicates a maximum level of relaxation. They usually rest between 12 and 18 hours per day and they prefer resting in groups or sustained on a firm surface [9]. Another important inherent activity is self-care of their hair (it could be considered as self-grooming) by using their legs, teeth and tongue. Moreover, the possibility of grooming other members of the group is important to its cohesion [9].

In addition, rabbits explore their area by sniffing, although this activity is frequently interrupted by stimuli that they perceive as threatening. When they get this alert alarm, they adopt specific postures such as sitting or standing on their back legs with the ears completely erect and orientated to the source of the stimulus. Another pattern related to these behaviours are freezing (total immobility of the animal) or kicking the floor or the walls to let the congeners know about a potential danger. These alert behaviours are especially important because they are predated animals, so they have a strong need to be alert and alert the conspecifics about potential damages.

As concern to social behaviour, wild rabbits live in groups and hierarchies are clearly established throughout aggressive interactions. According to [13], when kits go outside their mothers' nest area, they may come into contact with hostile conspecifics, but it is not until sexual maturity when aggressive behaviours become more important [14]. The hierarchic ranch is maintained over time within a stable group.

Regarding sexual behaviours, the evolution success of rabbits is due to "the number" [15], which means that wild rabbits tend to have big and frequent litters. In terms of maternal behaviour, attention paid to the litter is scarce, and the preparation of the nest 2–3 days before parturition and lactating once a day for a few minutes [16]

are the most remarkable related activities. Once the kits have been fed, the doe hides and leaves the nest and comes back for the next suckling event. Wild breeding doe opens the nest 18–20 days post-partum to allow the kits to go out and start to eat some solid food. When the kits are 24–25 days old, the rabbit does abandon the nest to be devoted to the next litter [13].

In general, some behaviours such as gnawing, hopping, social interactions, building the nest, lactating once per day and alert behaviours are a need for domestic rabbits, so they have to be considered when housing facilities for breeding does are designed.

2.3 Measurement of animal welfare

When we speak about animal welfare, it is important to remind that, as explained before, there are scientific methods to assess it. In general, there are different types of indicators of animal welfare that have been traditionally used:

- Resource-based indicators, which provide information about housing itself, such as temperatures, space allowance, air quality, noise, etc.

- Management-based indicators, which are related to managing practices such as handling or feeding, but also to specific practices of each specie such as dehorning or castration

- Animal-based indicators, which are those measured directly on the animals, such as physiological indicators, lesions, lameness or behaviour

However, there is no golden standard of welfare indicators, and each approach has to be adapted, depending on the objectives of the assessment, the conditions of the farm or even the requirements of the market. Nevertheless, it is generally accepted that animal-based measurements are the most useful and provide the most valuable information and approximation to the real state of the welfare of the animals [4]. Nevertheless, this does not mean that resource- and management-based measurements are not useful anymore, but they need to be combined with other more specific measurements.

Animal welfare indicators can be divided into two big groups: indicators for short-term and long-term problems.

It has been defined [17] that short-term measures are, for example, heart rate or plasma cortisol concentration, while some measures of behaviour, immune system function and disease state are long-term measurements. Housing conditions usually affect long-term indicators, as they act as potential chronic stress source. Transport or handling would be examples of short-term problems.

Some of the measures that can be performed to assess animal welfare are productivity, maintenance behaviours, abnormal behaviours, other behaviours such as maternal interactions, endocrine measures of stress, blood pressure, heart rate and respiratory rate, incidence of disease, level of immune protection and bone strength, and rate of injury and wounding [18]. As it is seen, all of them are animal-based measurements and display a multidisciplinary approach to animal welfare evaluation.

However, when housing conditions are evaluated, there is one aspect that has to be especially considered: the assessment of feelings, which means to know the real importance of the studied aspect for the animal. The main way to assess feelings in animals is through preference tests, in which the animals are allowed to choose between different possibilities. It is assumed that animals will make their choices according to how they feel [2] and we consider that animals make choices that are in

Figure 1.
Motivation cage constructed to assess the preference of breeding does for different sizes of cages.

their own best interests [19]. However, these tests can be influenced by the specific conditions in which they are performed, such as temperature, age, time of the day, season or previous experience. There is a tool to avoid these effects, and it is through motivation tests in which the strength of preference is assessed, and the animal gets a reward in response to some work [19]. An example of this test is shown in **Figure 1**, in which the rabbits could choose between three different housing cages, and ballasted push doors give access to each cage. Another possibility is the reactivity tests, in which the reaction or the fear to an environment or other stimulus is assessed (e.g., open field tests or tonic immobility tests [19]).

In summary, to develop a proper animal welfare assessment, physiological, behavioural and emotional needs have to be taken into account.

3. Conventional housing of breeding does

3.1 Development of current systems

Taking into account the behavioural repertoire of rabbits recently explained, one of the major concerns of commercial rabbits' welfare is related to housing and their equipment, as the restriction of the space may impair severely the development of specific natural behaviours, reduce the level of activity or increase the appearance of abnormal behaviours [20]. In the present commercial productive system, breeding rabbits (both does and bucks) are commonly housed in individual barren wire mesh cages, with no bedding material, although in alternative or organic systems, some straw-bedded pens can be found and does have a compartment to give birth (nest) and share the cage with the kits once they leave this nest, and they do not have any possibility to avoid each other during this period. These types of wire systems were developed in the 1960s due to hygienic reasons, as they allowed the separation between the animals and their faeces and urine. Nevertheless, these types of housing systems are being deeply criticised mainly in the European Union, and their evolution is being questioned. This evolution can be both to systems in which rabbits are housed alone or group housing systems, as we will see further.

The main welfare problem of individual cages is related to the impairment of certain natural behaviours, while the rest of the Five Freedoms are obviously guaranteed. However, some specific behaviours are allowed in caged systems, mainly all those related to peripartum and lactation, as a nest is allocated in the cage 2–3 days prior to the parturition to allow the doe to prepare the nest by mixing her hair with any provided material such as cotton, straw or wood shavings. Nevertheless, it seems that does have their preferences according to these materials, and when they can choose, they prefer straw to build the nest as compared to other materials such as wood shavings [21]. This could be due to the similarity between straw and the material they use in wild conditions.

In fact, the main concerns about these cages are the isolation of the rabbits and especially, the dimensions of the cages. Dimensions of individual cages vary between countries according to **Table 1** [8].

Some problems related to these cages are excess of lying time, locomotive problems or abnormal skeleton development [8]. But not only the width and the length are a possible problem, but also cage height, as it can avoid the development of alert behaviours such as sitting or standing with the ears erect.

However, although cages are the main concern in rabbit welfare nowadays, there are other housing conditions that may negatively affect the welfare of the animals. In fact, the environment that surrounds the animals and their characteristics are critical for animal welfare, and inadequate environmental conditions can favour the appearance of stress or sanitary problems. There are then five key aspects to control in the rabbits' facilities: temperature, relative humidity, air velocity, concentrations of dust and gases and lighting.

3.2 Foot mats

Conventionally, as it was said, rabbits were housed in wire mesh cages. In this type of floor, the incidence of pododermatitis (sore hocks) is high (up to 71.5% of animals [22] and 86.7% [23]), mainly due to does' weight and the long time spent in the same cage. Pododermatitis is a skin illness in rabbits that mainly appears in the back legs and causes pain and suffering to farmed rabbits [9]. Once it appears,

Country/Type of cage	Width (cm)	Length (cm)	Height (cm)	Available surface (cm^2)
France				
Young females	26–30	45–50	29–30	1200–1500
Lactating female with litter	40	90–100	29–30	3600–4000
Italy/Hungary				
Young females	38	43	35	1600
Lactating female with litter	38	95	35	3600
Spain				
Young females	30	40	33	1200
Lactating female with litter	40	85	33	3400
EFSA recommendations (2005)				
Breeding males and females	38	65–75	38–40	3600

NOTE: Dimensions without nest.

Table 1.
Summary of the dimensions of individual cages for breeding does in the main rabbit meat producers, European countries.

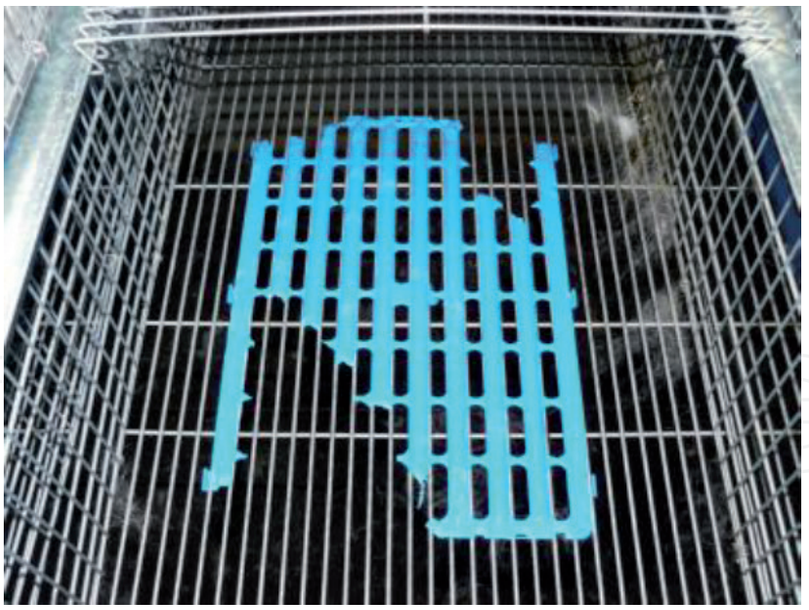

Figure 2.
Gnawed foot mat.

the wound can be colonised by pathogen microorganisms, enhancing the severity of this welfare problem. In fact, according to [9], it is considered that 16.5% of the culling rate in rabbit farms is due to pododermatitis.

In a deep study carried out by [24] about foot mats, they showed a positive relationship between their use and animal welfare. They found a significant reduction (81.3%) in the prevalence of sore hocks in farms where foot mats were used. This could indicate that the rabbits are more comfortable on this type of flooring and this seems to be confirmed by other studies [25] that found that rabbits clearly preferred foot mats over wire mesh when they can choose. By all these reasons, they became a "must" in the commercial rabbit houses nowadays, but it is important that they are in a good state of conservation, and foot mats gnawed or in bad conditions as that shown in **Figure 2** have to be avoided.

4. New models/trends in housing systems for breeding does

4.1 Individual systems with improved environments

Most of the studies that continue working on individual systems for breeding does focus now on environmental enrichment.

Environmental enrichment consists of adding complexity to the environment in which the animals live, by providing different elements that can help the development of certain behaviours, which cannot be performed without those additional elements. Thus, environmental enrichment can improve the quality of life of animals in captivity, as it allows them to fulfil specie-specific behaviours. For rabbits, environmental enrichment can favour activities such as gnawing, scratching, hopping and hiding. The main elements used to enrich rabbits' environment are as follows:

- Bigger cages: some standard cages have been modified to give the animals more available space to move freely. These cages can or cannot have more additional elements. Does in larger spaces are more active, as they perform more active behaviours such as locomotive ones [26], and when they are allowed to choose between different sizes of cages, they seem to be motivated for longer and

higher cages [27]. The importance of height can be due especially to the possibility of performing alert and exploratory behaviours.

- Gnawing elements: wood sticks or synthetic materials hanging on the walls of the cages or on the floor. These elements satisfy one of the most important needs of the rabbits, and it is performed independently of the housing system in which the animals are bred (see **Figure 3**). They also help to avoid the excessive growing of incisors [28], which is helpful especially in group systems, in order to decrease the intensity of the injuries when aggressive episodes take place. Moreover, this type of enrichment also leads to hygienic problems, especially when wooden sticks are used. As a consequence, there is a recommendation to fix the sticks on the walls or the ceiling of the cage instead of the floor, in order to avoid an undesirable contamination of the sticks by pathogenic microorganisms that could cause the animals severe illnesses [29].

- Refugees/hiding places: this type of enrichment is especially important when the breeding does are housed in groups, as they provide a place to the animals when they are threatened, so they can reduce the number of aggressions [30]. In fact, hiding places can even help to reduce the number of does culled as a consequence of aggressive interactions [31].

- Mirrors: they are a source of sensory enrichment, which is especially important for rodents and rabbits [32]. According to recent studies [33], mirrors act

Figure 3.
Gnawing sticks previous to allocation in a cage and after 1 month of use.

positively on the behavioural repertoire of the rabbits, as they might reduce the effects of isolation and they compensate the lack of social contact [34], so they become an interesting enrichment device in individual housing systems, although group living rabbits also showed preference for cages half covered with mirrors [35].

- Platforms (**Figure 4**): this is the most-studied enrichment in rabbit housing systems. According to different studies, does prefer jumping on elevated places if they exist [36, 25] and they use them to escape from the kits once they have left the nest.

According to our own unpublished results, breeding does use the platform mainly during the first 2 weeks of lactation, when the kits are still in the nest. During this period, the percentage of time spent on the platform reaches to 15% of time (**Figure 5**). During the third week of lactation, kits start to leave the nest, but they still cannot go up to the platform, so the doe uses it almost 35% of time, presumably to avoid the kits [37]. On the contrary, from the fourth week of lactation, the kits can rise to the platform and the percentage of time they spend on it is up to 66%, whereas the time of the doe decreases to 7% of time. From this moment, the use of the platform by the doe decreases and the kits continue using it up to 94% of the time, being clear the exclusion effect of the platform between does and kits. Moreover, some problems derived from the use of an elevated platform have been observed, mainly related to hygiene, as they can defecate and urinate in the platform (and beneath) and thus, the level of cleaning of both does and kits is reduced and the possibility of infection rises, as the animals are in contact with their faecal material [25, 38]. Daily health checking is also impaired because the animals are less visible and handling of the animals becomes more dangerous as does are hidden below the platform and defensive attitudes can be developed.

Figure 4.
Cages with elevated platforms in which breeding does standing and with erect ears can be observed.

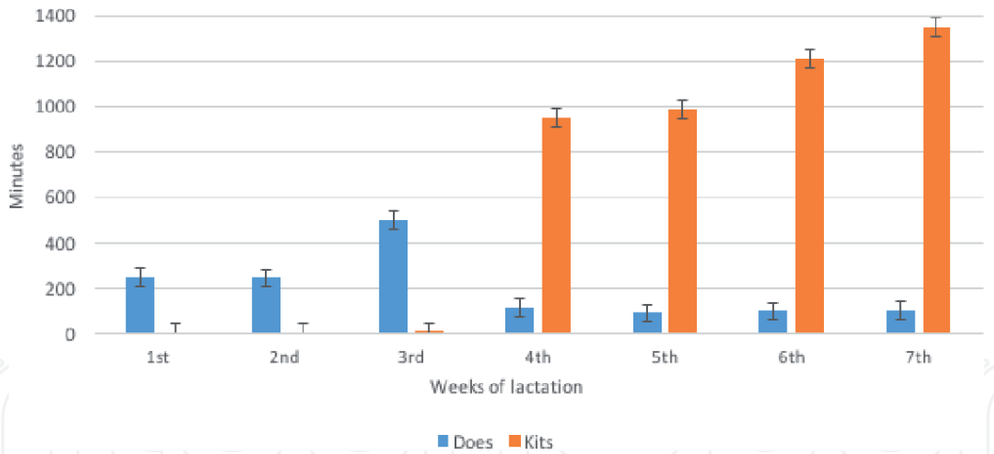

Figure 5.
Time spent by the breeding does and the kits on the elevated platform as the lactation period advances (unpublished results).

- Plastic floor, plastic mesh or slat: wire floor cages are being banned in certain Northern European countries such as Belgium or Switzerland [39], so there are several studies using alternative materials, such as slatted plastic floor. However, not all of them are suitable for countries such as Germany or Austria, where legislation requires specific dimensions of gaps. In general, common slats present good results both in production and leg health, but for example, slats with circular holes are not suitable for rabbit husbandry due to the level of dirtiness [39]. In general, the presence of plastic-slatted floors also decreases sore hock problems and improves doe welfare conditions [24].

- Litter flooring: some authors have studied the impact of housing rabbits on litter, but results show an impairment of productivity as well as enteric disorders. Ulcerative pododermatitis can also be increased when the rabbits are housed on litter, mainly in the hind legs [5]. In addition, choice tests do not show a preference for straw flooring as compared to wire and plastic flooring [40].

- Other sensory enrichment such as music has been revealed as useful to improve the well-being of the animals when they are housed in cages [41].

NOTE: some of these enrichment aspects have been implemented in the "WRSA cages", which are being used in newly renovated farms along Europe [5].

4.2 Collective housing

During the last years, there have been some approaches to develop group housing systems for breeding does. This grouping approach relies on the fact that wild does feed their kits once per day and they spend the rest of the day sharing time with conspecifics, leaving the kits in the nest.

When continuous group housing systems have been evaluated, several problems have been found, leading to unacceptable results in terms of welfare and productivity. Some of these were infertility, pseudopregnancy, high kit mortality and aggression [5], difficult health control, behaviour abnormalities, replacement of the does, higher productive costs [36], shorter lifespan and higher culling rate [5, 8]. Moreover, relationships among does are difficult in the first days after parity, and kit mortality is very high because of competition among does. They compete for the nests, attack the kits and sometimes raising of 2 or 3 does in the same nest box is found [5]. This can

be related to the previous explained theory about "the number", as rabbit does try to guarantee the success of their own litter, even if they have to attack other does' litters.

So the main reasons for the failure of this housing system are the very high rates of aggression among females and injured does and kits.

As a consequence, some Belgian research groups in 2011 (mainly ILVO and Ghent University, [42]) examined the possibility of a part-time group housing system, in which the does are kept in groups only some part of the lactation period (**Figure 6**). The does are group housed while they are pregnant, and 2 or 3 days before parity, they are separated (normally by closing a removable wall in their home park). They give birth and live with their kits during part of the lactation period, and between 11 and 18 days, the walls are again removed and the does are mixed. This means that they cannot fight at the peripartum and they cannot hurt each others' litters [43].

In this type of systems, does spend more time moving, sniffing and grooming, mainly after grouping [44]. However, aggressions are still present although the does give birth separately. Aggressions between does mainly take place in the first days after grouping, when the hierarchy has to be re-established [43, 45]. Furthermore, these fights can lead to severe injuries in the skin of the rabbits, they impair the body condition and sometimes, they have to be separated [46].

There are several factors that can affect the level of aggressiveness during the mixing process. One of them is the group size, as aggression level rises as the group size increases [47]. The other one is the age of the kits when the does are grouped. Interactions between does when the kits are 18 days old are lower than when they are 11 days old, as their capacity of moving and leaving the nest weaken the interactions between the mothers [46].

However, there are still some problems that need to be solved in these systems, such as the introduction of does to a previously formed group or the enrichment needed to allow alert and hiding behaviours. The does are commonly mixed after sexual maturity (mainly if it is necessary to remake the group), when the level of individual aggressiveness is higher [14]. Tunnels and hiding structures have been used [31], but they must ensure the possibility of inspection of the animals, as there

Figure 6.
Semi-group housing system in which removable walls can be observed, as well as hiding places and straw dispensers.

can be specific animals that hide in the structure and their level of fearfulness is so high that they do not move from that place, even dying from starvation. The revision of the animals in this type of systems is crucial, as well as the evaluation of the animals in order to separate them as soon as any especially aggressive animal is detected.

To correct some of these problems, some alternatives have been developed [48]. They proposed a system in which the breeding does are individually identified with an electronic chip, which allows the doe to enter only in its own nest (similar to the pregnant sows' system), avoiding kits' thefts and cannibalism. However, this system is valid for research purposes, but it appears unaffordable for commercial production, so new alternatives and improvements have to be searched.

5. Conclusions

Rabbits' welfare must be assessed from a multifactor perspective, considering productivity, health, behaviour and emotions. Current housing systems present failures when considering animal welfare. A deep research work is being developed to create new housing systems to promote an enhanced animal welfare level. Different strategies are being considered, from cage sizing, environmental enrichment, social interactions, etc. Although a golden standard has not been yet obtained, significant milestones have been achieved, which may encourage researches to keep working in this area.

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